

WHAT IS CLAIMED IS:

1. A wavelength division multiplexing ring network system which comprises an optical transmission line including at least a clockwise optical transmission line and a counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via said transmission line to transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of said optical paths, and in which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising:

means for setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending from said start node to said end node;

means for sharing said spare optical path among said current optical paths having different routes;

means for, when a node which terminates said current optical path detects a trouble pertaining to reception of an optical signal, outputting an optical signal to both said current optical path and said spare optical path, sending an alarm signal to an opposite



means for, when a node which terminates said  
5 current optical path detects the alarm signal,  
outputting an optical signal to both said current  
optical path and said spare optical path, and switching  
inputting of optical signals to said spare optical  
path.

means for setting a current optical path on a  
route via said clockwise or counterclockwise optical  
transmission line extending from said start node to  
said end node, and setting a spare optical path on a

means for setting a current optical path on a  
route via said clockwise or counterclockwise optical  
transmission line extending from said start node to  
said end node, and setting a spare optical path on a



route reverse to said current optical path extending from said start node to said end node;

means for sharing said spare optical path among said current optical paths having different routes;

5 means for, when a node which terminates said current optical path detects a trouble pertaining to reception of an optical signal, outputting an optical signal to both said current optical path and said spare optical path, sending an alarm signal to an opposite  
10 node of said current optical path having the trouble, and switching inputting of optical signals to said spare optical path; and

means for, when a node which terminates said current optical path detects the alarm signal,  
15 outputting an optical signal to both said current optical path and said spare optical path, and switching inputting of optical signals to said spare optical path.

3. A wavelength division multiplexing ring  
20 network system which comprises an optical transmission line including at least a clockwise optical transmission line and a counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via said transmission line to  
25 transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of said optical paths, and in



which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising:

5           means for setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending  
10           from said start node to said end node; and

          means for sharing said spare optical path among said current optical paths having different routes.

4. A system according to claim 3, further comprising means for setting said current optical path  
15           between nodes by a shortest route.

5. A system according to claim 3, further comprising means for setting said current optical path and said spare optical path in two ways between nodes.

6. A wavelength division multiplexing ring  
20           network system which comprises an optical transmission line including at least a clockwise optical transmission line and a counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via said transmission line to  
25           transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of said optical paths, and in



which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising:

5 means for setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending from said start node to said end node;

10 means for sharing said spare optical path among said current optical paths having different routes, and, when a node which terminates said current optical path detects a trouble pertaining to reception of an optical signal, outputting an optical signal to both said current optical path and said spare optical path, sending an alarm signal to an opposite node of said current optical path having the trouble, and switching inputting of optical signals to said spare optical path; and

15 means for, when a node which terminates said current optical path detects the alarm signal, outputting an optical signal to both said current optical path and said spare optical path, and switching inputting of optical signals to said spare optical path.

25 7. A wavelength division multiplexing ring



network system which comprises a plurality of nodes for transmitting and receiving a plurality of optical signals having different wavelengths, terminating optical paths, and switching connections of said optical paths, and a network manager connected to at least one node, and in which said nodes are connected into the form of a ring via at least a clockwise optical transmission line and a counterclockwise optical transmission line, and an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising:

means for setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending from said start node to said end node,

said network manager including optical path requesting means for requesting at least one node forming an optical path to set an optical path;

said node including optical path setting means for setting an optical path between nodes forming an optical path on the basis of the request from said network manager;

said optical path requesting means including means

10079497 000000



for checking whether an optical path can be set, means  
for determining a node to be requested to set an  
optical path, and means for checking whether said spare  
optical path can be shared,

5           said optical path setting means including means  
for setting an insertion wavelength of an optical path,  
means for setting a conversion wavelength of an optical  
path, and means for setting a branching wavelength of  
an optical path,

10           said means for checking whether said spare optical  
path can be shared including means for determining that  
said spare optical path can be shared when routes of  
said current optical paths set between nodes do not  
overlap, and requesting at least one node to set an  
15           optical path so as to form a new spare optical path by  
sharing an existing spare optical path, and

            said optical path setting means including means  
for forming a new spare optical path by sharing a  
wavelength used by an existing spare optical path, when  
20           requested by said network manager to form the new spare  
optical path by sharing the existing spare optical  
path.

8. An optical path setting method in a wavelength  
division multiplexing ring network system which  
25           comprises an optical transmission line including at  
least a clockwise optical transmission line and a  
counterclockwise optical transmission line, and a

10079497.022202



5 connections of the optical paths, and in which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising:

```
15      the end node;
```

when a node which terminates the current optical path detects a trouble pertaining to reception of an optical signal, outputting an optical signal to both the current optical path and the spare optical path, sending an alarm signal to an opposite node of the current optical path having the trouble, and switching inputting of optical signals to the spare optical path;

and

when a node which terminates the current optical path detects the alarm signal, outputting an optical



signal to both the current optical path and the spare optical path, and switching inputting of optical signals to the spare optical path.

5 9. An optical path setting method in a wavelength division multiplexing ring network system which comprises a plurality of nodes for transmitting and receiving a plurality of optical signals having different wavelengths, terminating optical paths, and switching connections of the optical paths, and a  
10 network manager connected to at least one node, and in which the nodes are connected into the form of a ring via at least a clockwise optical transmission line and a counterclockwise optical transmission line, and an optical path having an arbitrary wavelength is set by  
15 which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising the steps of:

20 setting a current optical path on a route via the clockwise or counterclockwise optical transmission line extending from the start node to the end node, and setting a spare optical path on a route reverse to the current optical path extending from the start node to the end node;

25 causing the network manager to request at least one node forming an optical path to set an optical path;

10079497.022202



causing the node to set an optical path between nodes forming an optical path on the basis of the request from the network manager;

5 causing optical path requesting means to check whether an optical path can be set, determine a node to be requested to set an optical path, and check whether the spare optical path can be shared;

10 causing optical path setting means to set an insertion wavelength of an optical path, set a conversion wavelength of an optical path, and set a branching wavelength of an optical path;

15 causing means for checking whether the spare optical path can be shared to determine that the spare optical path can be shared when routes of the current optical paths set between nodes do not overlap, and request at least one node to set an optical path so as to form a new spare optical path by sharing an existing spare optical path; and

20 causing optical path setting means to form a new spare optical path by sharing a wavelength used by an existing spare optical path, when requested by the network manager to form the new spare optical path by sharing the existing spare optical path.

25 10. An optical path setting method in a wavelength division multiplexing ring network system which comprises an optical transmission line including at least a clockwise optical transmission line and a



counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via the transmission line to transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of the optical paths, and in which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, comprising:

setting a current optical path on a route via the clockwise or counterclockwise optical transmission line extending from the start node to the end node, and setting a spare optical path on a route reverse to the current optical path extending from the start node to the end node; and

sharing the spare optical path among the current optical paths having different routes.

11. A method according to claim 10, wherein the current optical path is set between nodes by a shortest route.

12. A method according to claim 10, wherein the current optical path and the spare optical path are set in two ways between nodes.

13. A recovery method in a wavelength division multiplexing ring network system which comprises an optical transmission line including at least a



clockwise optical transmission line and a  
counterclockwise optical transmission line, and a  
plurality of nodes connected into the form of a ring  
via the transmission line to transmit and receive a  
5 plurality of optical signals having different  
wavelengths, terminate optical paths, and switch  
connections of the optical paths, and in which an  
optical path having an arbitrary wavelength is set by  
which an optical signal transmitted from an arbitrary  
10 start node through an arbitrary optical fiber is  
received by an arbitrary end node, comprising:  
    setting a current optical path on a route via the  
clockwise or counterclockwise optical transmission line  
extending from the start node to the end node, and  
15 setting a spare optical path on a route reverse to the  
current optical path extending from the start node to  
the end node;  
    sharing the spare optical path among the current  
optical paths having different routes;  
20 when a node which terminates the current optical  
path detects a trouble pertaining to reception of an  
optical signal, outputting an optical signal to both  
the current optical path and the spare optical path,  
sending an alarm signal to an opposite node of the  
25 current optical path having the trouble, and switching  
inputting of optical signals to the spare optical path;  
and

10079497 032203  
20220726 162007



when a node which terminates the current optical path detects the alarm signal, outputting an optical signal to both the current optical path and the spare optical path, and switching inputting of optical signals to the spare optical path.

14. A program for setting an optical path in a wavelength division multiplexing ring network system which comprises an optical transmission line including at least a clockwise optical transmission line and a counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via said transmission line to transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of said optical paths, and in which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, said program causing a computer to execute the procedures of:

setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending from said start node to said end node;

sharing said spare optical path among said current



optical paths having different routes;

when a node which terminates said current optical path detects a trouble pertaining to reception of an optical signal, outputting an optical signal to both said current optical path and said spare optical path, sending an alarm signal to an opposite node of said current optical path having the trouble, and switching inputting of optical signals to said spare optical path; and

when a node which terminates said current optical path detects the alarm signal, outputting an optical signal to both said current optical path and said spare optical path, and switching inputting of optical signals to said spare optical path.

15. A program for setting an optical path in wavelength division multiplexing ring network system which comprises a plurality of nodes for transmitting and receiving a plurality of optical signals having different wavelengths, terminating optical paths, and switching connections of said optical paths, and a network manager connected to at least one node, and in which said nodes are connected into the form of a ring via at least a clockwise optical transmission line and a counterclockwise optical transmission line, and an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is



received by an arbitrary end node, said program causing a computer to execute the procedures of:

5        setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending from said start node to said end node;

10       causing said network manager to request at least one node forming an optical path to set an optical path;

      causing said node to set an optical path between nodes forming an optical path on the basis of the request from said network manager;

15       causing optical path requesting means to check whether an optical path can be set, determine a node to be requested to set an optical path, and check whether said spare optical path can be shared;

20       causing optical path setting means to set an insertion wavelength of an optical path, set a conversion wavelength of an optical path, and set a branching wavelength of an optical path;

25       causing means for checking whether said spare optical path can be shared to determine that said spare optical path can be shared when routes of said current optical paths set between nodes do not overlap, and request at least one node to set an optical path so as

20250706 09:00:00



to form a new spare optical path by sharing an existing spare optical path; and

causing optical path setting means to form a new spare optical path by sharing a wavelength used by an existing spare optical path, when requested by said network manager to form the new spare optical path by sharing the existing spare optical path.

16. A program for setting an optical path in a wavelength division multiplexing ring network system which comprises an optical transmission line including at least a clockwise optical transmission line and a counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via said transmission line to transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of said optical paths, and in which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, said program causing a computer to execute the procedures of:

setting a current optical path on a route via said clockwise or counterclockwise optical transmission line extending from said start node to said end node, and setting a spare optical path on a route reverse to said current optical path extending from said start node to

10079497 022202



said end node; and

sharing said spare optical path among said current optical paths having different routes.

17. A program according to claim 14, further comprising a program for causing said computer to execute the procedure of setting said current optical path between nodes by a shortest route.

18. A method according to claim 16, further comprising a program for causing said computer to execute the procedure of setting said current optical path and said spare optical path in two ways between nodes.

19. A program for realizing a recovery method in a wavelength division multiplexing ring network system which comprises an optical transmission line including at least a clockwise optical transmission line and a counterclockwise optical transmission line, and a plurality of nodes connected into the form of a ring via said transmission line to transmit and receive a plurality of optical signals having different wavelengths, terminate optical paths, and switch connections of said optical paths, and in which an optical path having an arbitrary wavelength is set by which an optical signal transmitted from an arbitrary start node through an arbitrary optical fiber is received by an arbitrary end node, said program causing a computer to execute the procedures of:

10079497.022202



setting a current optical path on a route via said  
clockwise or counterclockwise optical transmission line  
extending from said start node to said end node, and  
setting a spare optical path on a route reverse to said  
5 current optical path extending from said start node to  
said end node;

sharing said spare optical path among said current  
optical paths having different routes;

20220726 16:45:00 F  
10 when a node which terminates said current optical  
path detects a trouble pertaining to reception of an  
optical signal, outputting an optical signal to both  
said current optical path and said spare optical path,  
sending an alarm signal to an opposite node of said  
current optical path having the trouble, and switching  
15 inputting of optical signals to said spare optical  
path; and

when a node which terminates said current optical  
path detects the alarm signal, outputting an optical  
signal to both said current optical path and said spare  
20 optical path, and switching inputting of optical  
signals to said spare optical path.